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A Phenomenological Study on the Natural Rhythms of Light: Implications on Educative Design in Haiti

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I am submitting herewith a thesis written by Jonida Paqesor Shehu entitled "A Phenomenological Study on the Natural Rhythms of Light: Implications on Educative Design in Haiti." I have examined the final electronic copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Architecture, with a major in Architecture.

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Vice Provost and Dean of the Graduate School

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A PHENOMENOLOGICAL STUDY ON THE NATURAL RHYTHMS OF LIGHT: IMPLICATIONS OF EDUCATIVE DESIGN IN HAITI

A Thesis Presented for the
Master of Architecture
Degree
The University of Tennessee, Knoxville

Jonida Shehu
August 2011

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DEDICATION

I dedicate my work to Mr. Kenneth Simons, for his inspiration, wisdom and patience.

ACKNOWLEDGEMENTS

First and foremost, a sincere thanks to all who contributed to this thesis and offered me their guidance. A special thanks to John McRae for being much more than a diligent advisor, but going beyond his role to offer me his guidance and intelligence; to James Rose for his unmatched insight and his inspirational wisdom; to Barbara Klinkhammer, for her wonderful support throughout the process; to Avigail Sachs for her thoughtful lectures, inspiring conversations, and eye-opening advice from the very beginning; and to Elizabeth Ferguson for her patience, kindness, and constancy in making sure the whole process went along smoothly. Thanks also to Jean and Joy Thomas for opening their hearts and their home to me while in Haiti.

My deepest gratitude also goes to the following people for their continued moral support during a time when I am sure I more than often came short of being a good sister, daughter, fiancée and friend; Bochie, Mami and Babi, Brian Rocks, Joleen, Rose, Curls, AWA, RRR, Marta, Shuchita.

ABSTRACT

This thesis explores a design project concerned with the relationship between the person and nature in the context of achieving a state of symbiosis between the two – a state which can be reached through highlighting the relationship between the person and the rhythmic characteristics of natural light. The project originated from a concern with modern society's constant separation from the natural environment and the resulting sense of placelessness often experienced in the spaces created. In response, a desire arose to investigate the effect that natural light has on the person and contribute to the design of naturally enriched spaces where light is used as the link between the person and the natural environment.

We are constantly influenced by the prevailing conditions of light. Our biorhythms are in tune with the natural changes from day to night, the duration and intensity of sunlight and the spectral composition of light. However, in an attempt to create the optimum formula for comfort, efficiency, and productivity, we are using advanced lighting technology to create uniform interior spaces detached from the ever-changing exterior environment. The outcomes of the study are to inform the practice of design and architecture and to use the findings in a beneficial manner towards the design of educative spaces.

In response to the need for a secondary school in Fond des Blancs, Haiti, I want to focus on the chosen site and program, and investigate the rhythms of light and their effects as they are related to the specific location and the purpose of education. Moreover, I want to use the results to create a set of design guidelines for the specific location and function of the buildings to find out how biorhythmic design can be used for the creation of an educative environment where natural light is channeled, maximized and utilized for the goals of the learning process?

PREFACE

Stemming from a long-time interest in the effects of light on the human body, I decided to undertake this issue as a thesis topic in order to gain a more thorough understanding of the effect that natural light has on the learning process specifically. I have chosen a phenomenological approach to design in order to address the experience of the space holistically and not simply in a practical, statistical manner.

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INTRODUCTION

Thesis Question

How would a phenomenological study of the natural rhythms of light aid in the design of a secondary school in the village of Fond des Blancs, Haiti?

Thesis Statement

This thesis involves revealing the rhythmic qualities of space in terms of its experience through a diagrammatic analysis of combinations of program, space and time, and the ever-changing qualities of natural light. The aim of the study is to understand the essence of that experience; how it is generated through the connection of the person's biorhythm with the cyclical rhythms of natural light. By referring the findings in relation to the qualities specific to the given site and the educative program, I hope to reveal a beneficial use for highlighting this innate relationship, and respond to it through the design of a series of spaces that would address the goals of a secondary school in Fond des Blancs, Haiti. I believe my findings will also be fundamental to designing multicultural spaces for a society across a spectrum of environments such as work, home, and public spaces.

SUPPORTING ARGUMENT

Separation From Nature

As can be seen most frequently in the post-industrial workplace, lighting has not been a priority for the design of offices, regardless of the large amount of the day spent within them. As a result, people have resorted to other artificial solutions for solving the innate human need for sunlight. As Angela Nahikian, manager of Market and Business Development for Lighting, Steelcase Inc., confirms, many business travelers use melatonin in tablet form to help them maintain their work efficiency and performance when they travel to locations in different time zones. What most people do not realize is that the solution lies in simply increasing one's exposure to light, thus naturally altering the body's melatonin levels.[1] Today, people have become so removed from the rhythm of nature, they cannot see that rather than creating a chain of artificial methods in search for a solution, the problems can be solved through simply the recognition of the benefits associated with maintaining a rhythm with nature. In fact, scientists have recently discovered a photoreceptor cell in the eye that is responsible for converting daylight into energy. The receptor is not linked to vision, rather it processes light into chemicals that help to regulate the human circadian cycle, body temperature, blood pressure, moods, and other body functions.[2] Several studies have been done to prove the direct alerting effect that light has on the circadian regulation of sleep and waking performance. However, in modern society's race for efficiency and production, our connection to nature is often overlooked.

Situational Context

In the midst of my thesis research, I discovered the site and program when I found out of the need for a secondary boarding school in Fond des Blancs, Haiti and a project funded by the Haiti Christian Development Fund and its leader, Jean Thomas. This context presented a situation where natural light was not just an option, but a necessity. I decided to apply my research of light to the specifics of the given program and site and quickly discovered that the abundant uniform light in Haiti was not as much of a blessing as I initially thought. The limitless light was attached to an unbearable amount of heat for most of the year. During my visits there, I came to realize that this connection between the two had to be avoided as effectively as possible.

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[1] Steelcase. "Seeing the difference: The importance of quality lighting in the workplace." Grand Rapids, MI. Steelcase Inc. December 1999

[2] Perrin F, Peigneux P, Fuchs S, Verhaeghe S, Laureys S, et al. "Nonvisual responses to light exposure in the human brain during the circadian night." Curr Biol. 2004;14:1842–1846.

Personal Background

I believe that a significant aid for me in conducting this study was my background in Albania. Having lived in a country where similar issues prevailed, I've grown up with an understanding for how the lack of a grid and artificial energy does not allow for a lifestyle separate from the rhythms of natural light. With this in mind, I believe that I can offer a different approach from the typical tendencies to impose western ways of thinking onto the situation. Because of the ten years I lived in Albania, a country that, at the time, could not be reliant on the grid system for the basic services, I understand what it means to have to rely on and maintain a relationship with the natural environment. Similarly, in Haiti, natural light dominates the rhythms of daily life. This relationship remains a primary concern which I plan to address and respond to throughout the process of my thesis.

DESIGN INVESTIGATION

Scope/Limits of Investigation

In this thesis, I am not simply addressing natural light and how people are affected by it. Instead I am responding to the way in which rhythmic light affects the program addressed and the spaces necessary for this program. I am investigating designs that respond to the changes in natural light and the way in which they adapt to the various types of light created by the sun's different positions in the sky and various times of day, and year.

Throughout the process I attempted to follow 2 paths, the quantitative, and the experiential. For the first I studied light at times of day in that environment, the daily school activities, the spaces necessary for these activities to take place and at what time of day, as well as the amount of light necessary for this to occur. The latter was more difficult to define but also more powerful. It allowed me to observe the quality of light necessary to create the experience of each space. Through the use of both I was able to stage the architecture of the spaces I focused on. As I will go on into more detail later, I decided to focus on six spaces that I found to be crucial in representing a well balanced and evenly varied distribution of the treatment of light at different times of day and types of space. Although later on in the study I focus on these six experiences, my initial analysis of the qualitative and the prescriptive include the entire program.

Site Discussion

Currently, the country of Haiti is one requiring help in many areas. I had the opportunity to experience this first hand when I joined a team of students to visit the site and make plans for the design of a school and road project being undertaken simultaneously with this thesis project. In the dialogue of my current thesis project, I researched the site elements and took them under consideration in the design phase. Figure 1 shown on the following page portrays a few glimpses of common elements of the culture, habitat, and nature found in Haiti.

Figure 1
Photos from Haiti

Site Analysis

As a result of its geographical location variations in sunlight received and the resulting climate in Haiti remain relatively unchanged, allowing for outdoor living conditions year round and thus a facilitated synchronization to the natural rhythms of light.

The days in Haiti remain relatively consistent during all months of the year, and the need for electricity is not felt as much as it is in the winter months in some of the more northern locations. Haiti's latitude facilitates the maximization of natural light even in the winter months when school remains in session. Therefore, since the detachment aforementioned is not the same for a Haitian as it is for a North American, I believe the chosen location will be beneficial in exploring the possibilities in working with natural light. However, as aforementioned, in connection to the uniform light, Haiti also experiences a uniform heat that must be avoided to achieve comfort. This proves to be a challenge when the intent is to create spaces that are as open to natural light as possible since avoiding direct heat gain associated with sunlight is a high priority.

Figure 2 on the following page portrays the difference in latitudes between Knoxville, Fond des Blancs, and the equator and puts the heat gain and light patterns affected by this in perspective.

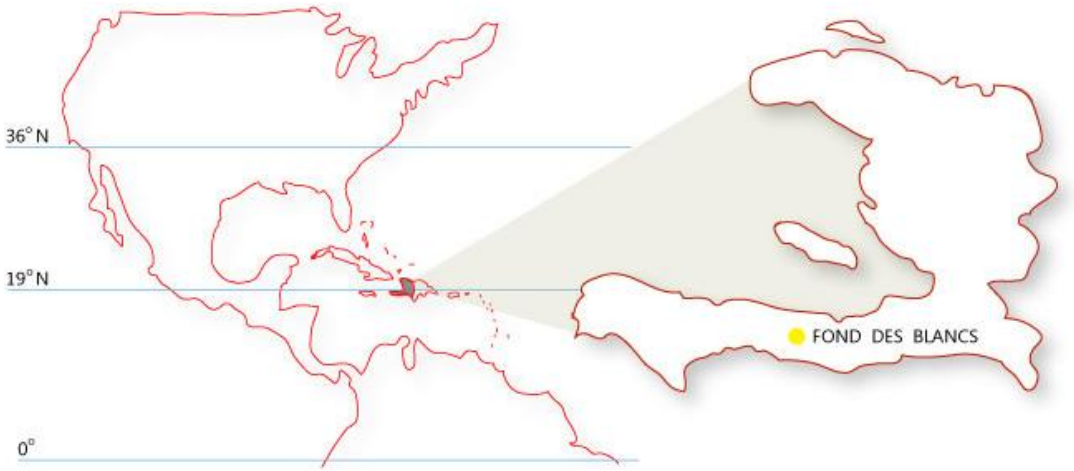

Figure 2
Map Comparing Latitudes of Knoxville, Fond des Blancs, and the Equator

Case Study

During my trip to Fond des Blancs, I had the chance to visit a school that has recently been built in the area. This one was a primary school with a younger age group than the one being planned, however, it addresses similar programmatic issues. In fact, Jean Thomas, the leader of the HCDFand the organizer of the plans for a new school regards this school as a primary precedent for the new one in terms of program, discipline, and organization. However, as can be seen in the pictures in Figure3, and as I noticed when walking around the classrooms and hallways of the building, many of the spaces were not properly lit for the experiences they inhabited. Pools of light flooded the classrooms causing glare on task surfaces. Most classrooms were not properly oriented for the time of day that class was conducted, resulting in direct radiation and severe heat and discomfort in the space. On the contrary, the light in the hallways was insufficient for purposes of egress.

Figure 3
Photos of the primary school recently built in Fond des Blancs

Specified Program

The program of the school is set by Jean Thomas. It will be a secondary institution that will be used on a daily basis in addition to inhabiting boarding students staying overnight.

The physical spaces required include but are not limited to:

- 1 classroom/grade level (7 20x20 rooms for approximately 30 students)
- Library
- Teacher's common space
- Administrator/Principal's office
- Large cafeteria used by school and dormitory students
- Separated kitchen adjacent to cafeteria
- Computer room
- Central corridor/transition spaces
- Indoor restrooms
- Courtyard/green space used to connect all school and dorm spaces as well as to provide light
- Film space in the form of a large, lecture type space, an auditorium or an amphitheatre with a stage or performance space.
- Fine arts room for music, art, ceramics or sewing
- Life skills room as a multipurpose space

Based on the given program, the spaces I found to be most effective of studying light in an educative environment are as follows:

- the flag ceremony space,
- the in between spaces such as hallways or transitory spaces,
- the classrooms or learning rooms
- the library or story telling room
- the dining or socializing space
- the dormitory or reflective and meditative space.

Although I felt it best to focus on these spaces for further exploration of design, I took under consideration the whole program throughout my research analysis. Keeping these required spaces in mind, I want to use my exploration of light as a vehicle in making recommendations on how the design of these spaces could be approached. By using a phenomenological response, I want to single out common experiences in a space and address them cohesively through designing in response to the natural light necessary to provide the experience in each space.

PRECEDENTS

As examples for the approach to responding to a space through the experience of the participant, I have been observing a few of Alvar Aalto's libraries. In a study of six of his libraries, a comparison of two conceptual approaches to day lighting helps to understand the difference between the sequential and the phenomenological analyses. The first, and the most popular (Figure 4, left column) is to consider light in the sequential terms of source, path, and target, with arrows representing light direction. This concept provides an accurate basis for intuitive understanding only when the light emanates from a point source. The second approach, (Figure 4, right column) considers illumination as what can be "seen" by the target. This approach is based on the amount of light at the target, the result of exposure to all the bright and dim surfaces within the view of the target.[3]

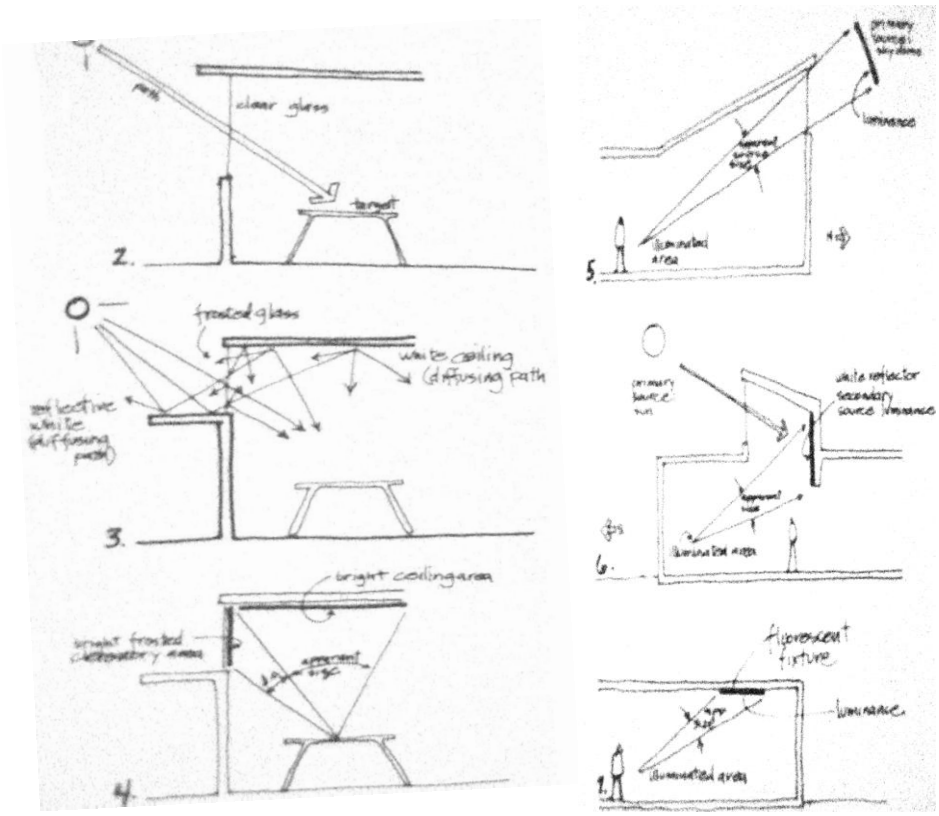

Figure 4.
Alvar Aalto's Sketches for His Approach to Designing for Natural Light.

[3] Moore, Fuller. "Six Aalto Libraries." AIA Journal. 1982.

Aalto's approach, similar to the second, is focused on the target and the way light is experienced from there. Some of his sketches for the spaces in his libraries show this approach with arrows starting at the target, or point of interest, and lead to the areas of illumination to illustrate that the target can "see" these areas. Shapes, such as curved reflective light scoops. skylight configurations and clerestories are used to respond to the illumination level necessary for the target spaces.

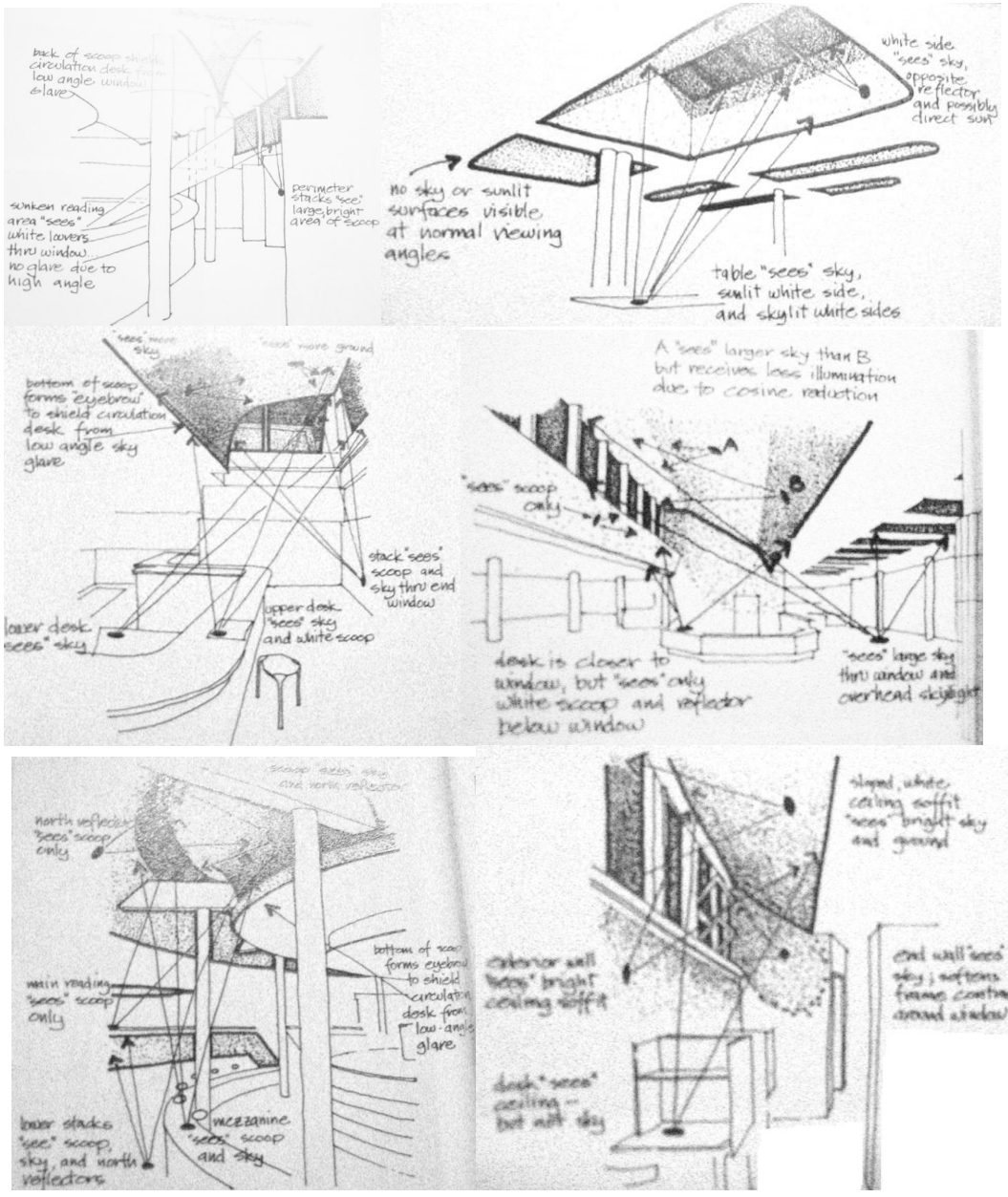

Figure 5.
Alvar Aalto's Sketches of His Libraries

The spaces Aalto has created through this approach address light in a phenomenological way, responding to the personal experience of the individual within the space. The rendering of the spaces in each of the six studied libraries, (Figure 5), portray and describe the experience as a result of the way that light interacts with the space and the target seeing it. Because I want to gain a holistic understanding of the various qualities of light in a space as a result to the changing natural sunlight, I will use the phenomenological approach as a guideline in conducting my own study.

DESIGN APPROACH

Exploring Light

Researchers are continuing to learn more about the phenomenal scope of the biological functions that are related to light and the natural rhythms of day and night. Disruptions in these rhythms often show a significant range of physiological and psychological effects on humans.[4]

For the purposes of this project, I will be addressing various types of light, prevalent in all seasons in Haiti and responding to each through different solutions. By means of sketches of the relationship between light, space, and dwellers, I will conduct a phenomenological study of the resulting experience in addition to gathering data for the quantitative approach. The sketches below portray some of the diagrammatic ways in which light affects space and is affected by space.

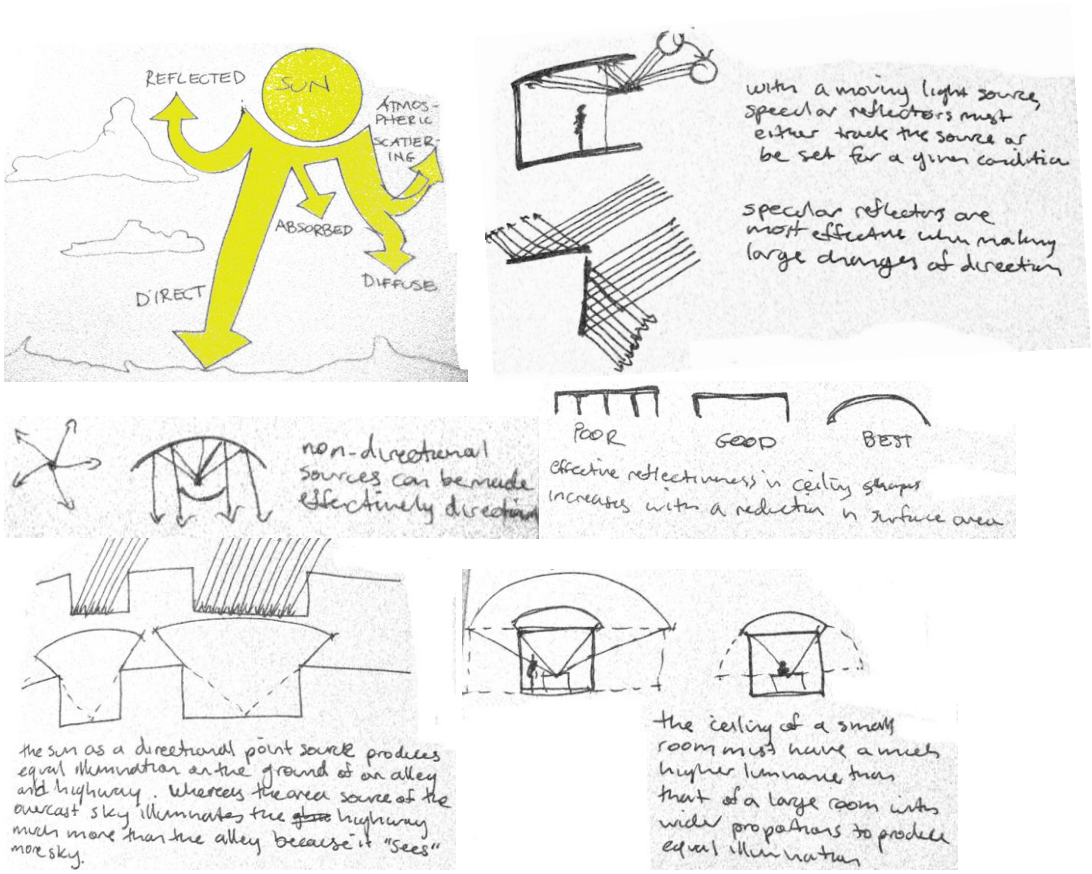

Figure 6
Sketches of Various Light Behavior

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[4] Gallagher, Shaun, and Dan Zahavi. *The Phenomenological Mind: An Introduction to Philosophy of Mind and Cognitive Science*. London: Routledge, 2008.

Type of Approach

Many times in our profession, were most accustomed to an analytical approach on how to use light, in my thesis, I am emphasizing a way to integrate the experiential aspect to the work as well. My approach, which requires maintaining a balance between the wanted and unwanted solar radiation, the positives and negatives of sunlight, begins with an overall understanding of light and how it behaves to affect perspectives and experiences. It is then specified to include the dimension of time, orientation, location, form and materials. I took under consideration the two main approaches that I discussed earlier, these being the quantitative and the qualitative.

Quantitative Analysis

I began with the quantitative approach, analyzing the site in terms of the type and amount of sunlight available and its effects. I compared this to the parameters that we are used to experiencing in Knoxville and included information on the humidity and its role. I, then, researched the desired orientation and shape of a building for the area and applied the specific program to the amount of light necessary for its function as well as the optimum arrangement for the given spaces. I also compared schedules of the dorm and daily students as well as those of teachers and staff and lined up the program with the time of day that each space would be used by them to obtain patterns in the schedules. I researched schedules further looking for psychological answers to the optimum time for use of each part of the program and lastly observed the circadian sleep-wake cycle to further explore the best times for each activity.

Location and Light

Being 19 degrees north of the equator, the sun is higher in the sky for most of the year in Haiti whereas at 36 degrees, in Knoxville, the daily and annual patterns of sunlight vary greatly with the seasons. In Haiti, regardless of season, the amount of daily sunlight remains relatively the same, the shadows cast at different times of the year are quite predictable from season to season, further facilitating a closer relationship with natural light. Figure 7 below shows the amount of sunlight each place experiences on an annual and daily basis.

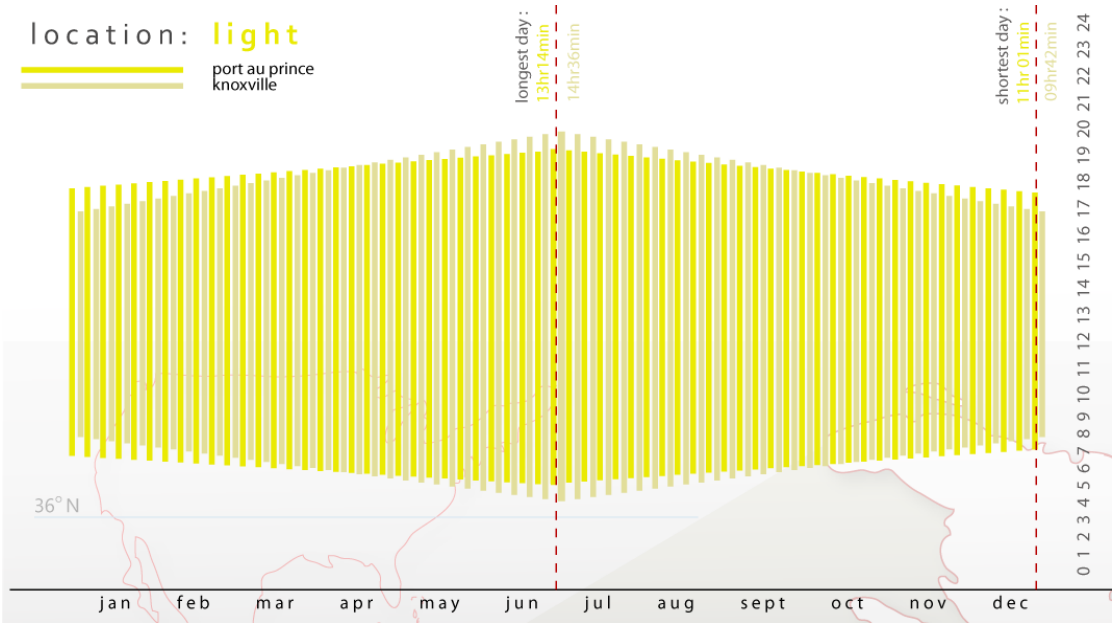

Figure 7
Comparison of Daily and Annual Light between FdB and Knoxville

As can be seen in Figure 8 on the following page, I compared the shadows at different times of day and year between Fond des Blancs and Knoxville to get a general idea of the type of light I would be dealing with. In addition to the type of light, I also pointed out the humidity in Haiti at corresponding times of year to show the amount of heat also associated with the sunlight. I highlighted the times of day and year when the humidity in FdB is too high so that even the shade does not provide comfort. The figure on the following page is made up of three columns showing the two solstices and the equinox and six rows divided up horizontally for three different times of day. For each specification there is a plan of a 20' x 40' building shown to provide a general example of the type of shadow it would cast under each circumstance. The humidity is pointed out through the intensity of color signified by the horizontal bar at the bottom left of the image and the time is the vertical axis signifying months.

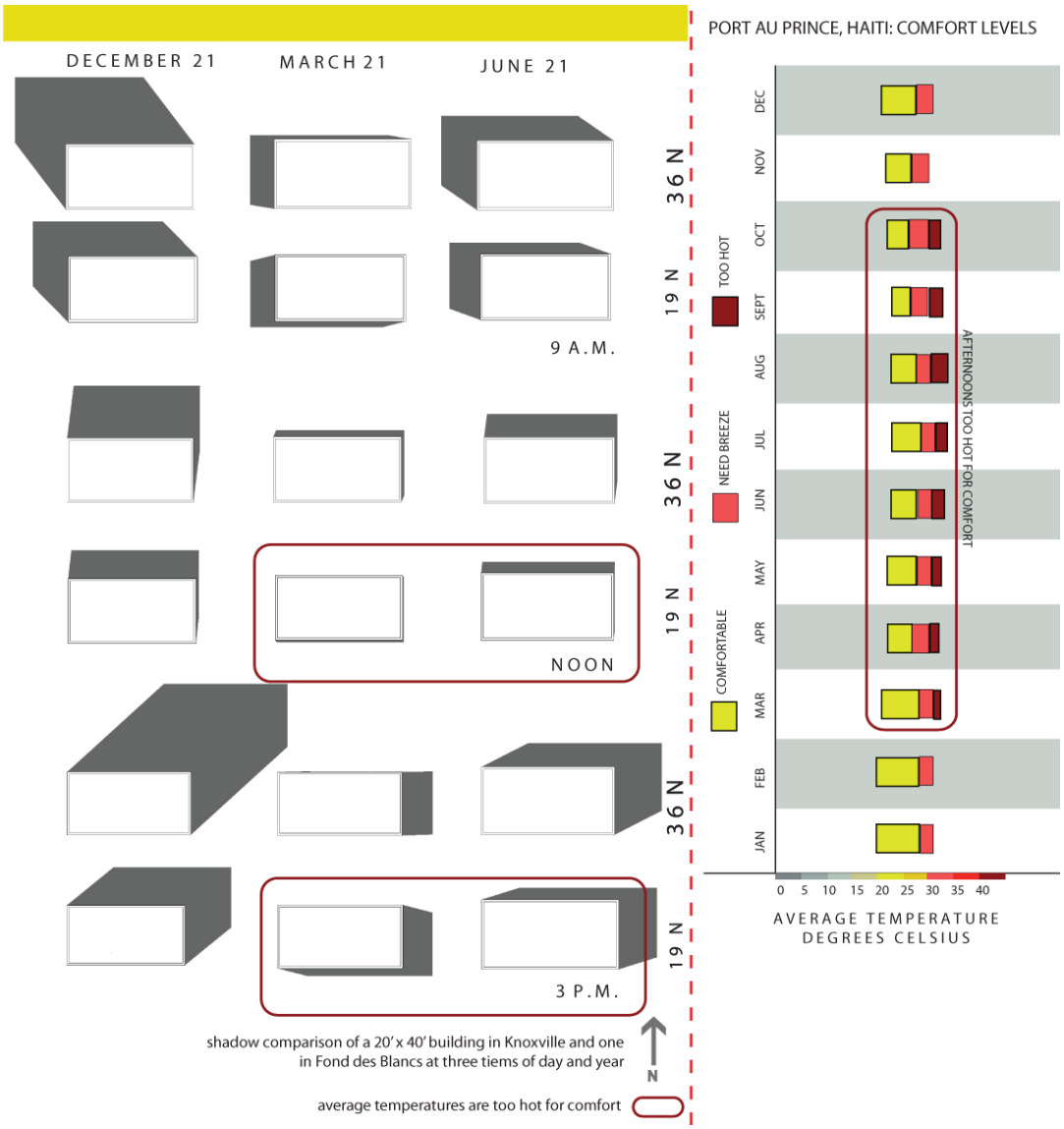

Figure 8
Comparison of Shadows and Humidity

Optimum Orientation

For optimum orientation, the longer sides of a building, with the most windows, should face north and south in this climate and the roof overhangs should shade the walls and windows in the middle of the day. The east and west sides should be kept short in these climates to avoid the long angled light and associated heat gain. Figure 9 on the following page demonstrates this study as well as showing a scale of the best to worst orientation for a building in this location and climate.

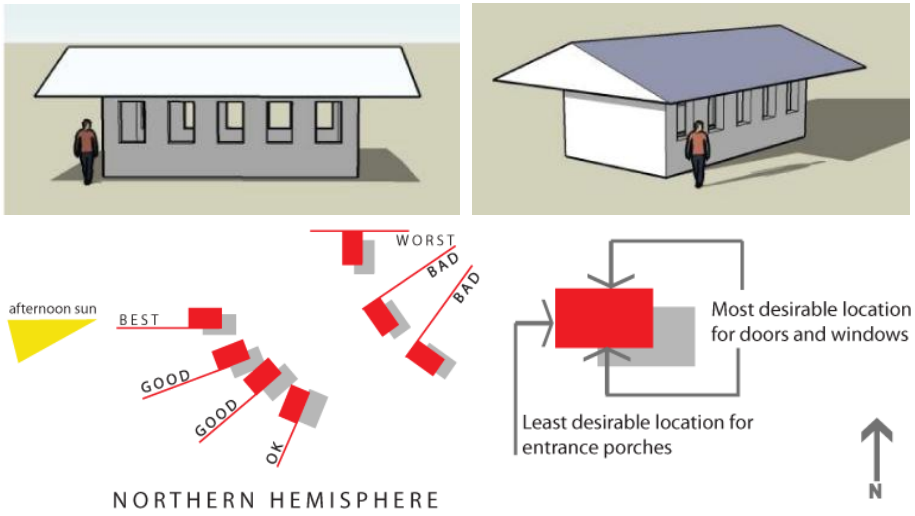

Figure 9
Optimum Orientation

Programmatic Studies

I continued my analysis through programmatic studies of the given program of spaces as required by the client. Jean Thomas I took these parameters and grouped them in ways meaningful to interconnections between them, and aligned them in reference to their specific needs of the amount of sunlight necessary for use of the space.

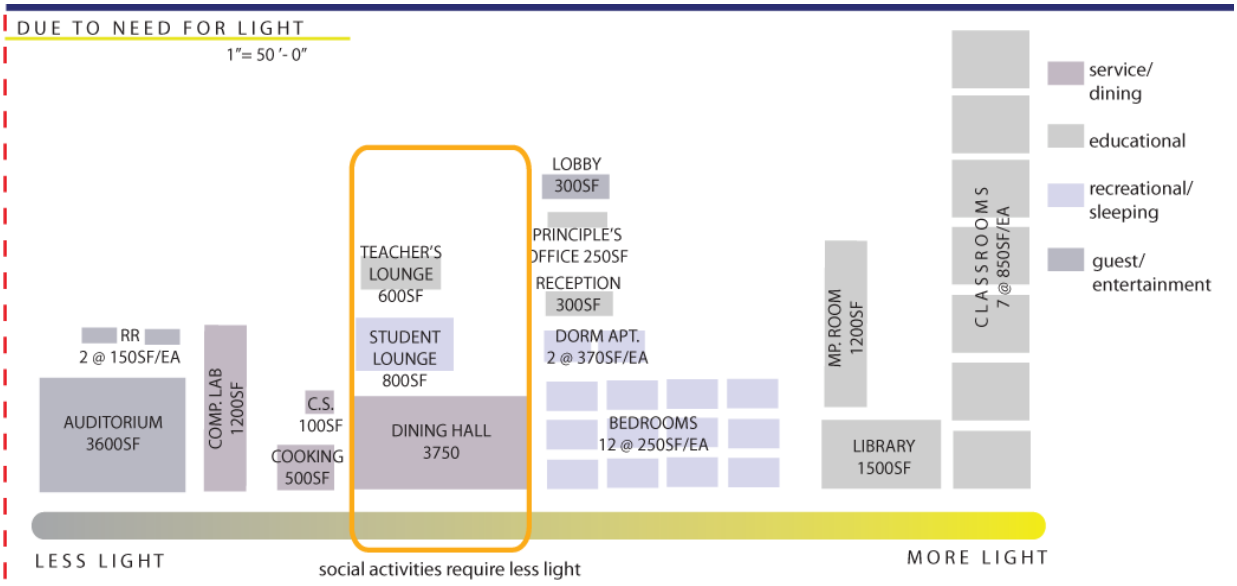

Figure 10
Program arranged by need for light

Figure 10, on the previous page, shows that the spaces in need of most light are the classrooms closely followed by the library, those able to function in lack of light are the auditorium followed by the computer room. In this image, spaces where the most social activity occurs are highlighted due to research I found showing that Haitians like to tell their stories in the dark

In addition to the program's relationship to light, I also took under consideration the program's interrelationships within itself. Figure 11 below shows the groups formed through arrangement of spaces and the circulation necessary between each. It shows the categorizations formed through this arrangement facilitating consolidation within buildings during the design phase.

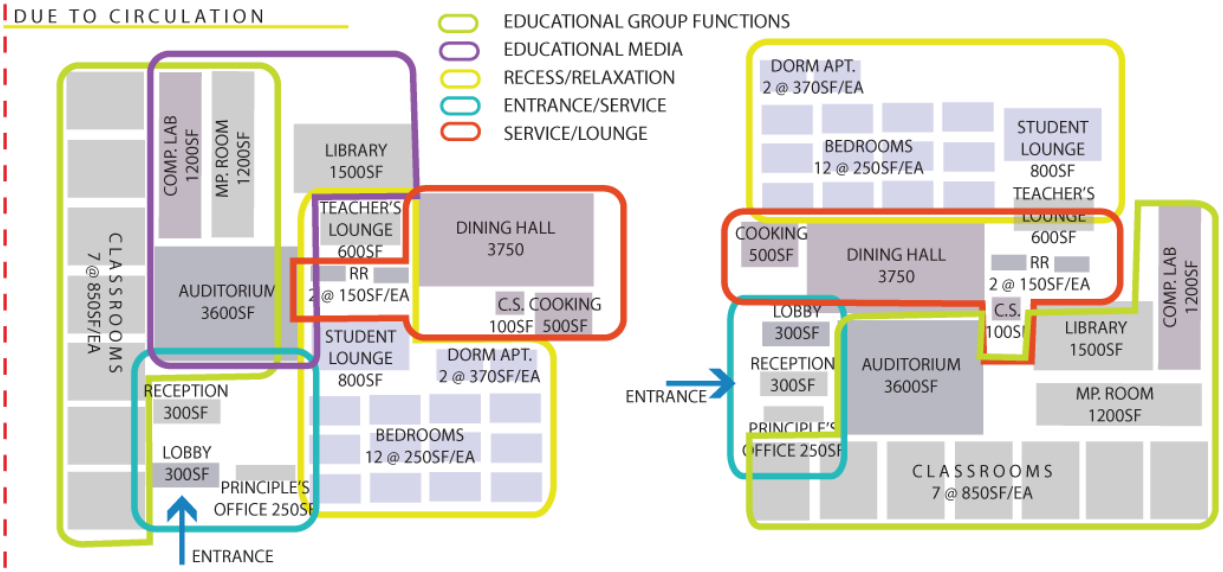

Figure 11
Program arranged by circulation

The analysis of program continued with the arrangement of space due to the schedules of people throughout the day. Figure 12 on the following page is divided up into the student activity and the teacher activity showing a parallel of schedules between the two due to the use of space for each and the time of day it is used. Similarities can be seen between the two in the morning and noon when both groups use the classrooms and dining rooms with the exception of the use of the teachers lounge. In the evening the students use the dorms and the teachers leave for the day so the schedules begin to differ.

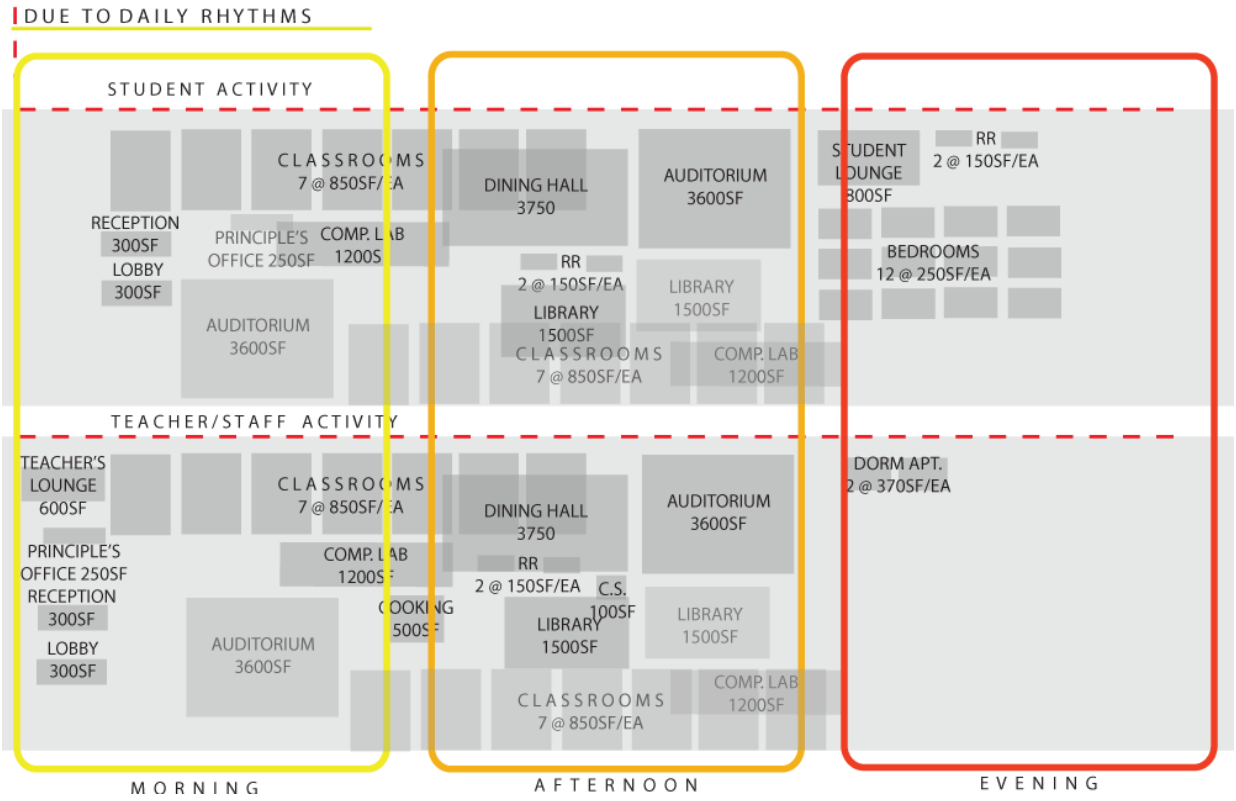

Figure 12
Program Arranged by Daily Rhythms

School Activity

Being given a little leeway as to the time of day that each space was to be used, I researched the psychological background for the optimum time of day to perform general school activities. In my research, I found that creative and physical activity is best done in the morning and logical activity in the afternoon. In Figure 13 below, I broke down the program associated with these activities and created tables to place them among other time specific activities such as the flag ceremony and lunch.

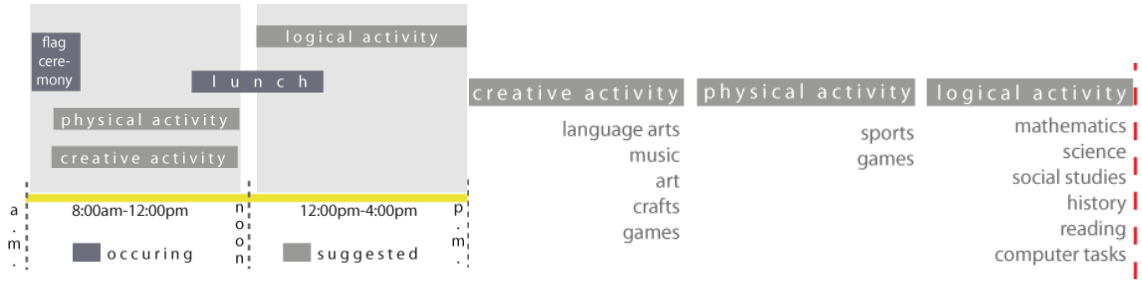

Figure 13
Time for Activity

Circadian Rhythm

As part of my qualitative analysis, I also studied the body's circadian rhythm and the s and c processes and their cycles of alertness at various times of the day to determine the best biological time for certain educational tasks. Figure 14 below shows the two processes the S, being the quantitative need for sleep depending on how long one is awake and how active he/she is while awake, and the C, being the natural tendency for the human body to sleep during the sleep phase.

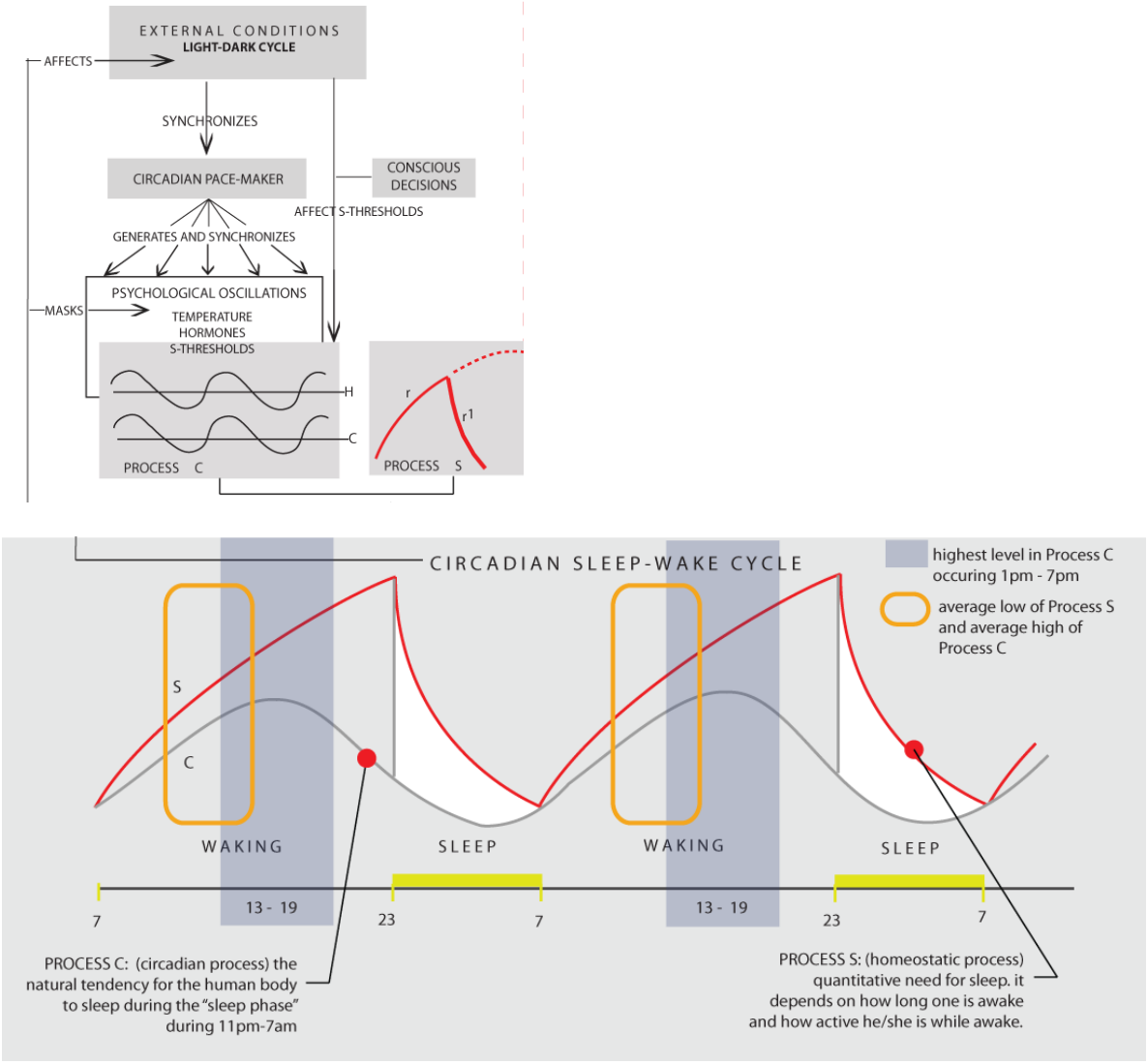

Figure 14
Circadian Sleep-Wake Cycle

Local Light Treatment

A common treatment for light and ventilation in Haiti is a clostra. It is used in almost every building as a replacement for windows. This type of local treatment provides a method of safety for the inhabitants and their belongings. Clostra work best for this location due to their ability to eliminate the need for glass as a material but also they divide up the direct sunlight, which in this climate, can be a large problem. Figure 15 below shows six common examples of clostra found in the surrounding areas of Fond des Blancs.

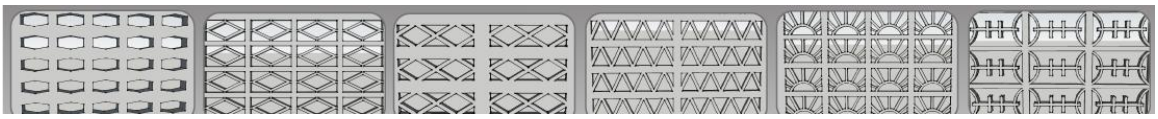

Figure 15
Haitian Clostra

Suggested Light Solutions

To conclude the quantitative analysis, I researched several light solutions that could be applied to the location. In my analysis I pinpointed the type of light that would be disruptive in the learning environment. Figure 16 shows this by illustrating reflected glare, direct focused light, and direct pools of light.

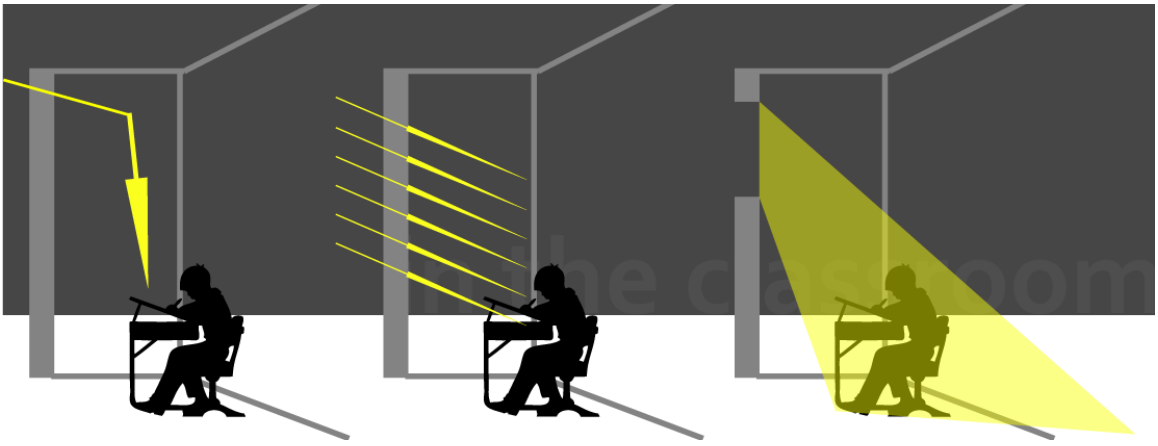

Figure 16
Light Penetration

In continuation, I researched a series of window and roof treatments that could be applied to provide a substantial amount of shade in openings as well as a series of opening methods. Figures 17, 18, 19 and 20 illustrate a few of these methods.

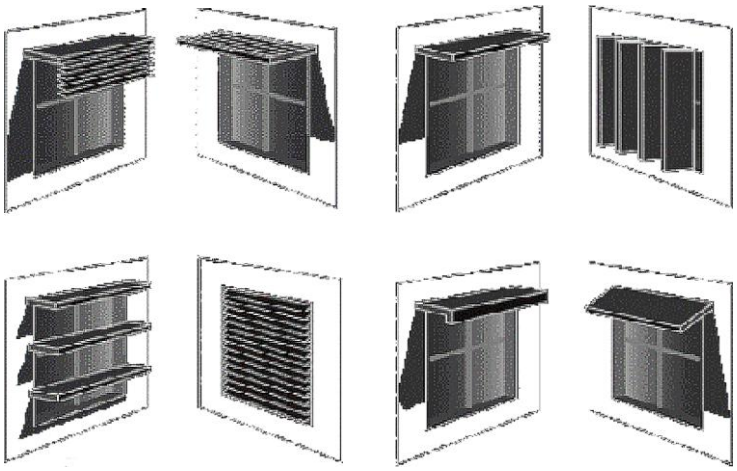

Figure 17
Window Treatments

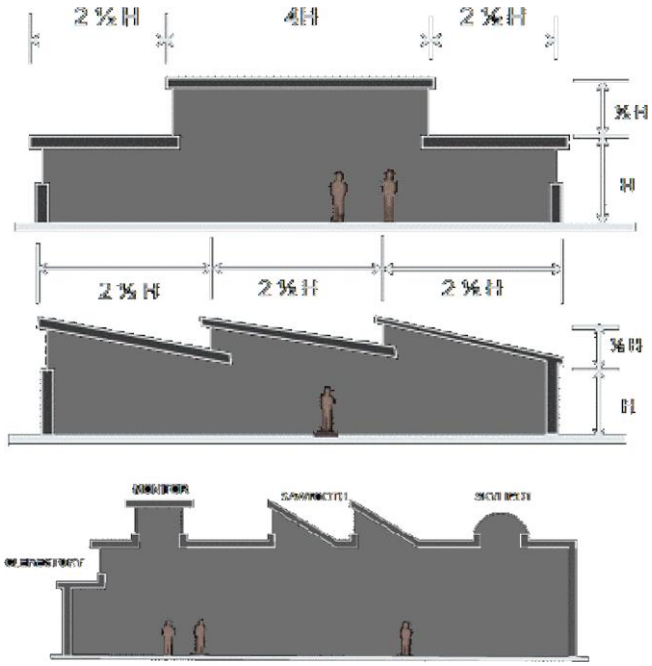

Figure 18
Roof Treatments

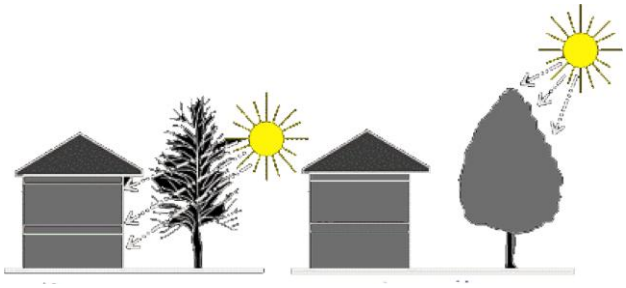

Figure 19
Trees and sunlight

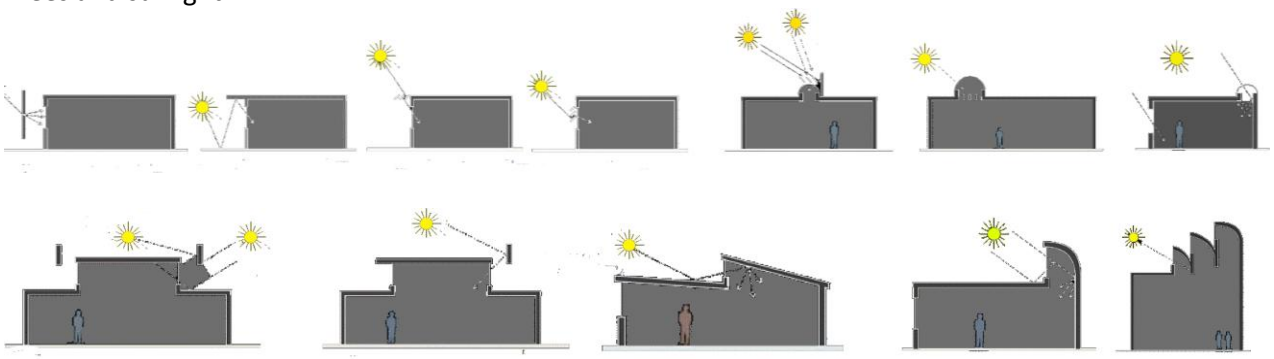

Figure 20
Building Shape Treatments

Site Design

Even though I felt it best to focus on the six experiences mentioned earlier, I took care in designing the site plan for all the spaces required. The site is composed of five major elements which are organized in such a way to take advantage of the context in the most effective and meaningful way. Two courtyards, the academic and the recreational, serve as the main organizing factor for the campus. The site also has a main axis linking the two courtyards and serving as the main circulation path for multiple times of day. There are interior and exterior spaces arranged in a way which was informed by my earlier programmatic studies of grouping due to interrelationships and specific need for light. When I discuss the individual spaces later, I will tie them into the site individually. There is a primary entrance to the south, closest to which are the classrooms and the auditorium withholding faculty spaces. A secondary entrance is located at the northern end of the site, adjacent to which stands a small parking area. This also acts as the service entrance to the dining hall.

Figure 21
Site Plan

The floor plans shown in Figure 22 on the following page portray a more detailed look at the organization of space. Level 2, shown first, includes the plans of the only two buildings on campus that have a second floor, the library and the classrooms. Both of these spaces are off the academic courtyard providing shaded spaces below for circulation throughout the day. Level 1, shown second, details the plans of all the buildings while keeping the profiles of the second floor shaded.

Figure 22
Floor Plans, Level 1 and 2

Qualitative Analysis

Each space that I focused on gives an opportunity for exploring light in a different way, at a different time of day, at a different function. For each, I started with an experience and an emotion that I wanted to convey within the space. I did watercolor studies, and took pictures of the site at various times of day to get a feel for the light at that time. To achieve a holistic approach, I took under consideration the path of the sun at the times of day the space would be used and designed solutions for treating this light accordingly.

To take the experiential aspect beyond just these six spaces, I also generated a series of site sketches of the path that daily and dorm students and that of the faculty and staff. They show times of congregation, transition and linkage throughout the site. The sketches shown in Figure 23 below also employ both the perspective and qualitative approaches through the use of a site plan with appropriate shadows, a cone of vision of where the view is taken and the time of day the path is taken and by which of the campus users.

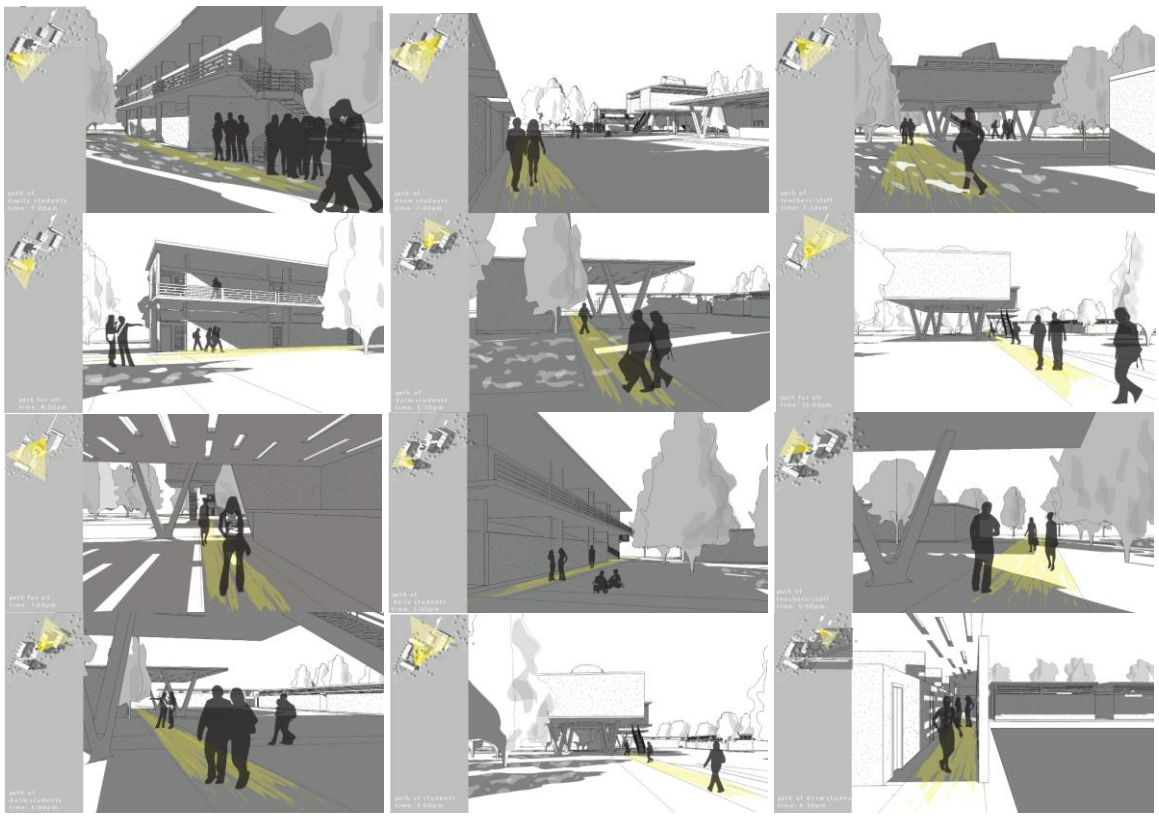

Figure 23
Site Renderings

Each experience includes a quantitative and qualitative side. Each has a rendering of the time of day the space would most typically be used, including a site

plan with the respective shadows on the site at that time of day, the sun path and angle for that space at that time of day, as well as a diagram showing the ritual of space usage with respect to other spaces on campus. Below each space are the shaded section and a plan of that individual space.

Ceremonial Gathering

Beginning with some background of the ceremonial gathering, it is customary in Haiti for the flag ceremony to take place every morning before classes begin. For this event, an instrument is usually played or children will sing. To capture the essence of the experience, I oriented this space east so that the silhouette of the flag could be seen against the early morning sun. I generated the view using the actual trees from that spot on the site at the actual time of day the ceremony would be, at 7:30. I elevated the flag, through a set of steps arranged in a place that can be seen directly from the main entrance of the school but do not disturb the main axis of the site.

Figure 24
Ceremonial Gathering: Qualitative

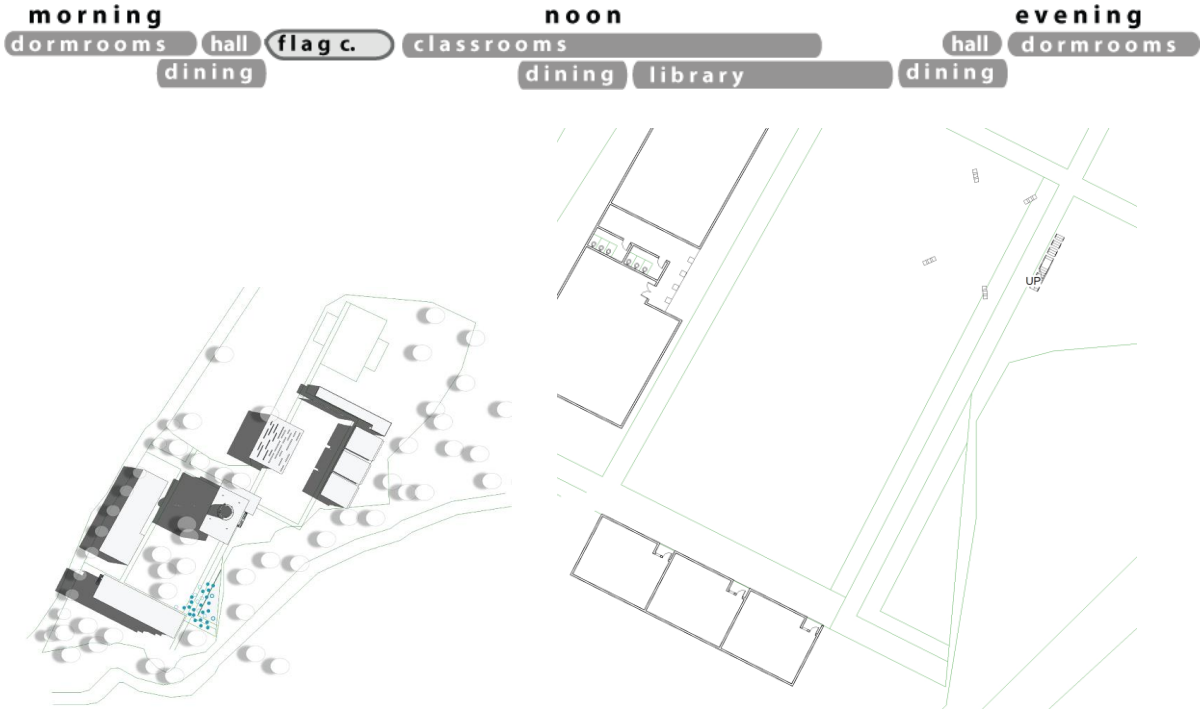

Figure 25
Ceremonial Gathering: Quantitative

Movement through Light

The transitory space, or hallway, used in the morning and afternoon, allowed me to explore how light can affect movement in the space. It is the only space where direct light enters the interior through slits of clostra. The space houses one of the perimeter paths of the recreational courtyard and is adjacent to the northern dorms.

The sharp slits of light emphasizing movement in the space, also portray the transition between indoor and outdoor. Slits of light as they come into contact with moving bodies render form more clearly than a more uniform lighting would. Because this spaces is used strictly for transition between other spaces, I felt it appropriate to use light to aid in portraying this movement. The southern wall as well as the roof of the space are characterized of long narrow slits where light spills into the space and the pools of light created on the interior vary depending on the different time of day the space is experienced.

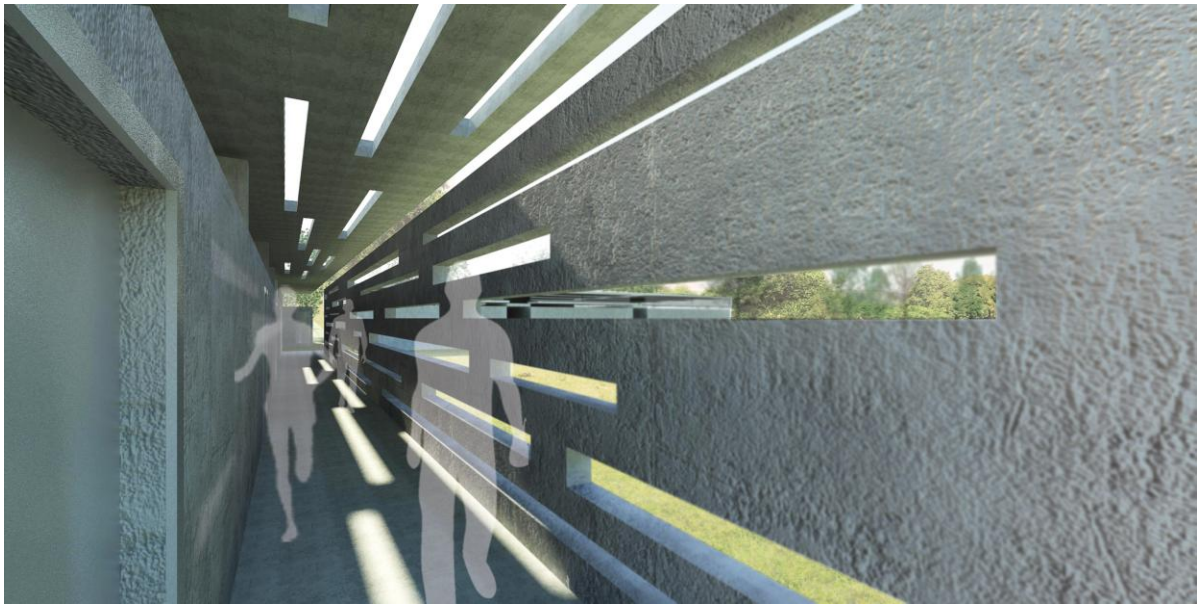

Figure 26
Movement through Light: Qualitative

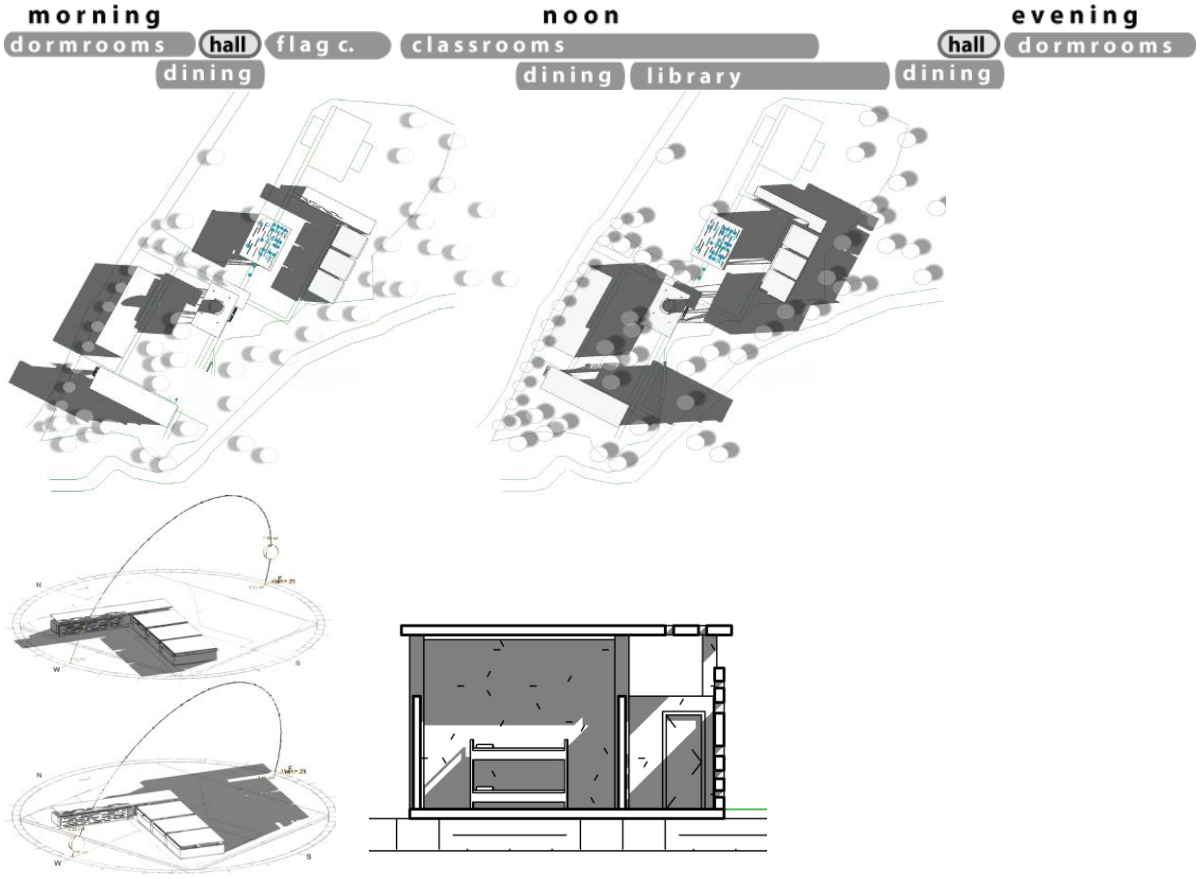

Figure 27
Movement through Light: Quantitative

The Learning Garden

The classrooms are organized into three on the first floor and four on the second, all at 750sf each, as per the parameters given. This organization leaves a shaded gathering space at the entrance of the campus allowing waiting space for carpoolers as well as student socializing space. Each classroom is lit up by the diffused southern morning light. No direct light enters the rooms and openings are concentrated at higher elevations for minimizing distractions. With the use of a light shelf and a hanging curved shell structure my intent was to create a deep penetration of light within the space and an even illumination throughout the room. The doors are recessed creating a compressed entrance where a feeling of awe is generated upon seeing the space become larger upon entering. Above the hanging reflective ceiling, ventilation occurs through the high openings to the north and south of the rooms. Figure 28 below shows the rendering of the space while Figure 29 on the following page gives the quantitative information for it.

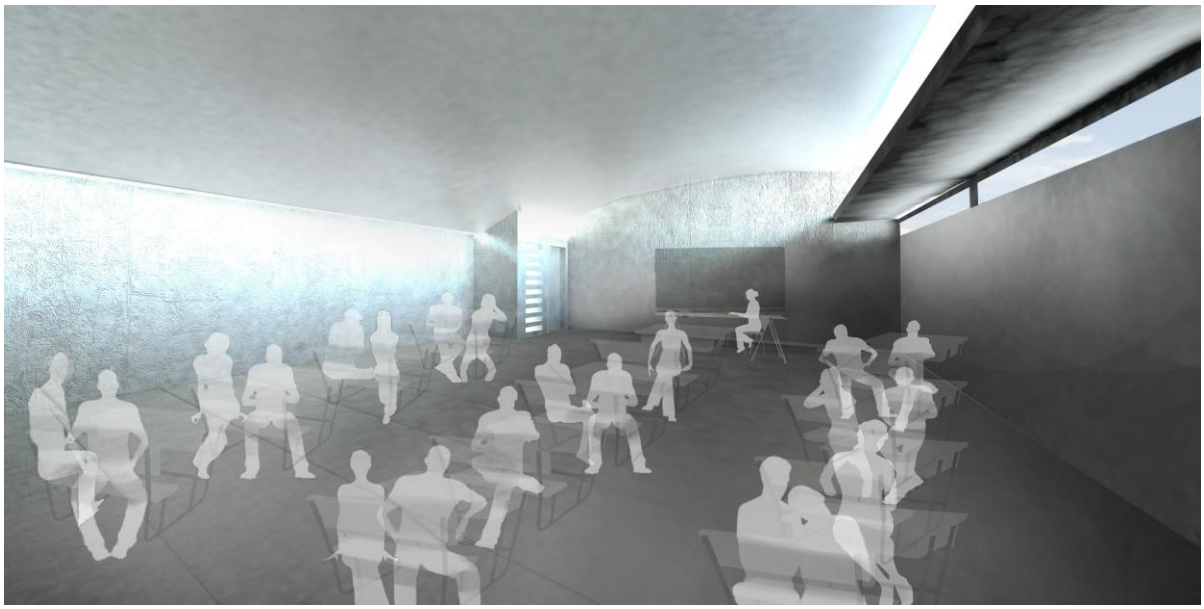

Figure 28
Learning Garden: Qualitative

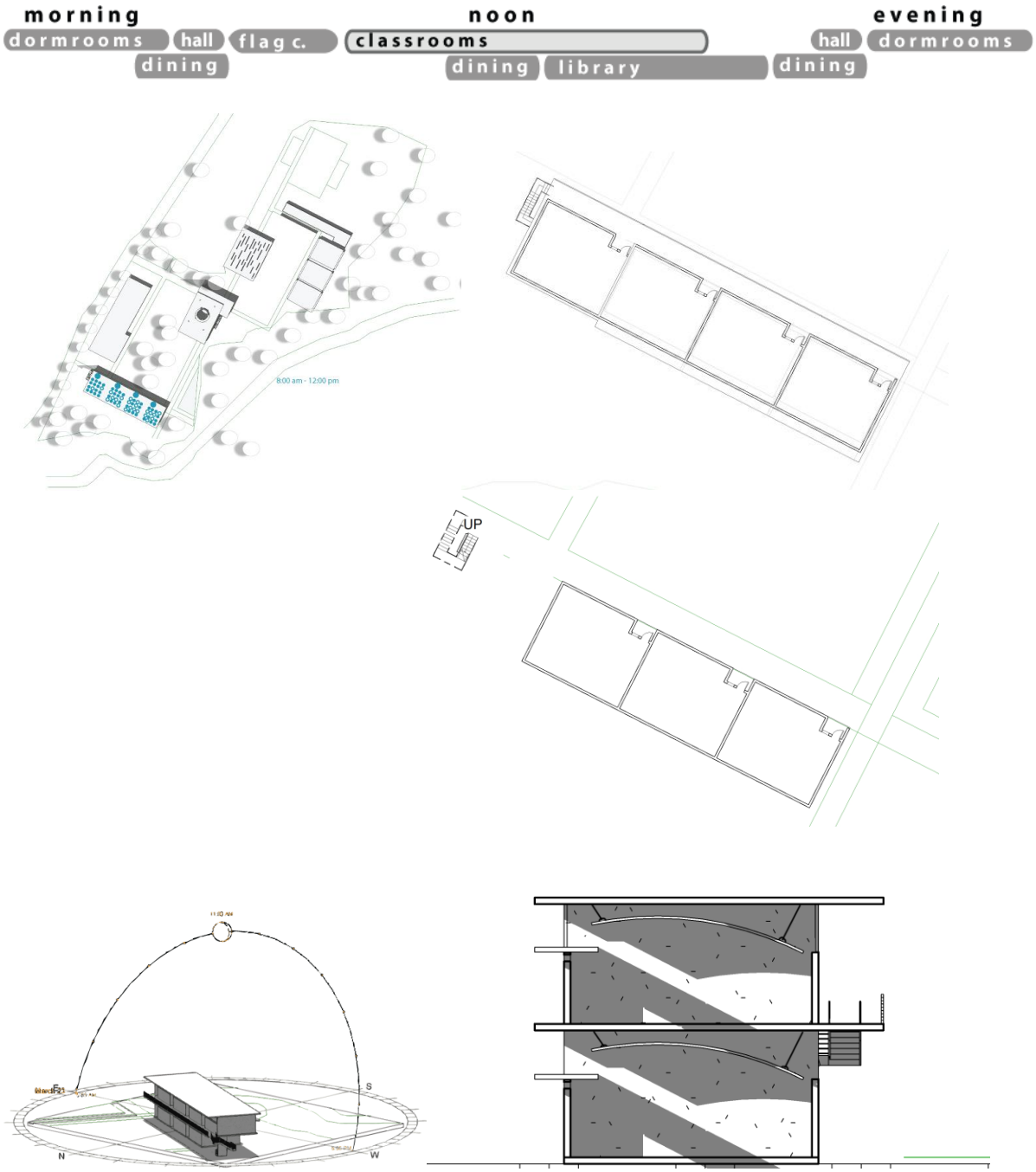

Figure 29
Learning Garden: Quantitative

Storytelling Space

The library acts as the focal point of the campus, with a central oculus acting as a beacon of enlightenment. Its elevated above the main axis as a symbolic reference but also provides shade for the path below. The entrance to the library is through a set of stairs leading up to the east side of the building. The oculus is oriented toward the northern sky avoiding direct sunlight penetration and defines a central gathering and story telling area in the middle of the space. For supplemental light, I used horizontal slits high in the walls and light shelves above the books for a diffused glow making reading easier. To the north of the building i placed clerestories to provide light for the offices but kept the separation walls shorter to allow for this northern light to enter the main space as well. Columns holding up the space continue the cone shaped language of the oculus down to the ground floor as slits in the perimeter of the central floor of the library supplement this language by allowing the light from the oculus to shine through. Figure 30 below shows the rendering of the space while Figure 31 on the following page gives the quantitative information for it.

Figure 30
Storytelling Space: Qualitative

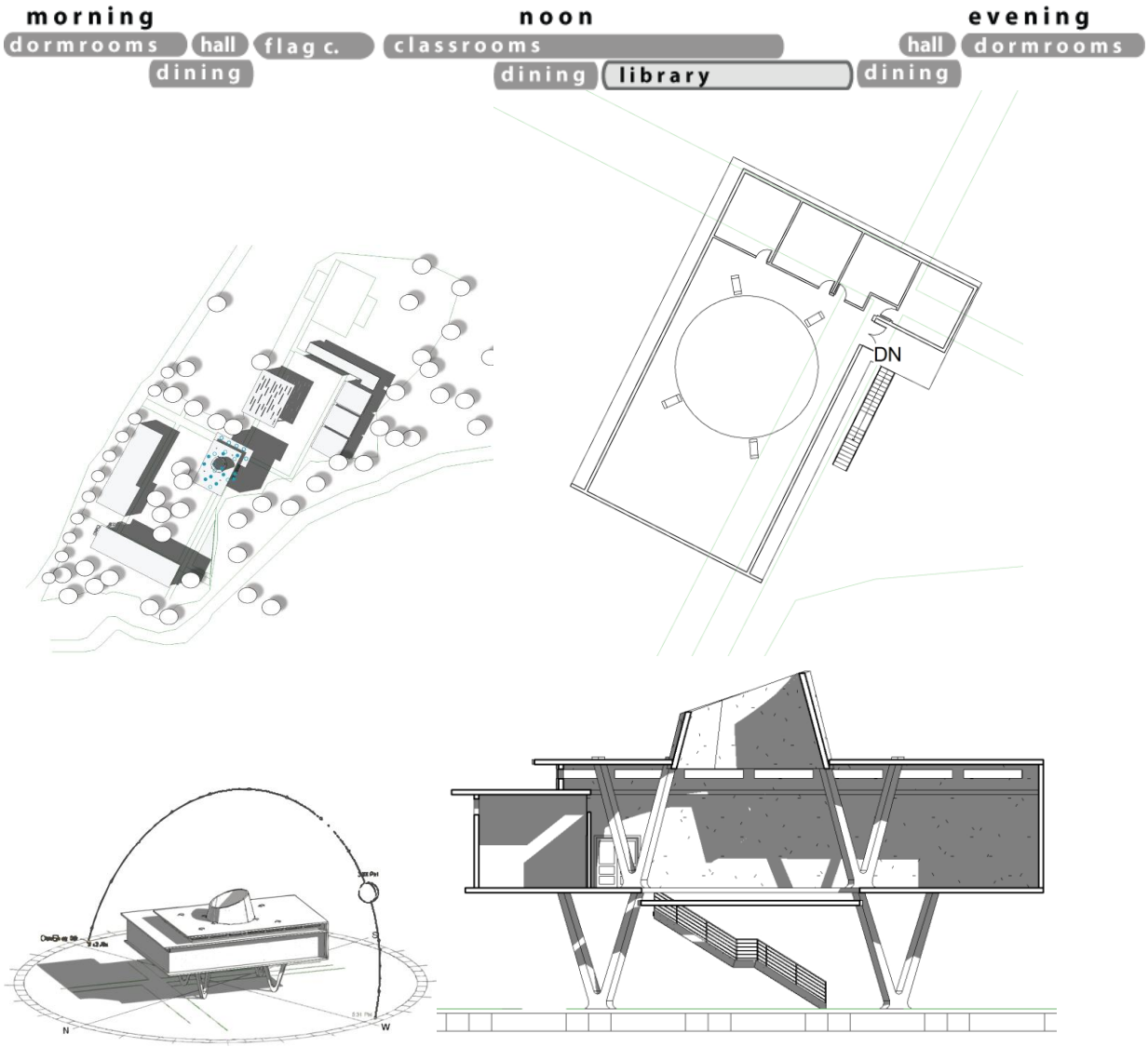

Figure 31
Storytelling Space: Quantitative

Ethereal Dining

The dining space, serves as a socializing space for meals in the middle of the day and at the end. Although I addressed both types of light affecting the space, I rendered the light at dusk. The space straddles a path on the site and traffic runs through it for most of the day. It is oriented east with views toward the courtyard so that no direct light is allowed in from the west to eliminate heat gain while the space is used at for dinner. The slits in the roof, reinforcing the path below, are openings in the concrete filled with plastic containers holding water and chlorine. Water serves for the diffusion of light and the chlorine keeps mold from growing. The solution allows for up to 60 watts of light for each opening. Figure 32 below shows the rendering of the space while Figure 33 on the following page gives the quantitative information for it.

Figure 32
Ethereal Dining: Qualitative

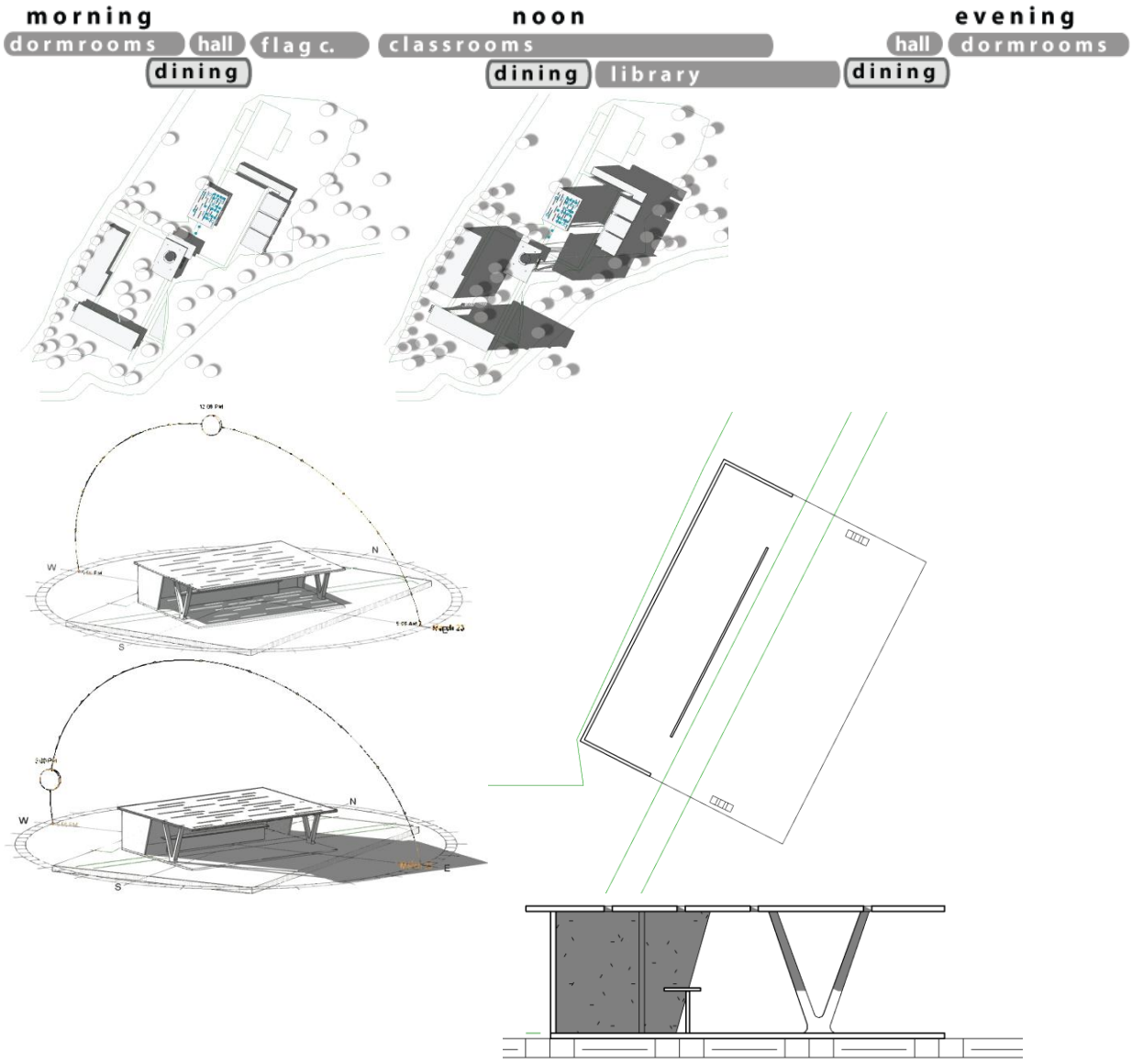

Figure 33
Ethereal Dining: Quantitative

Sleep Haven

And finally, I felt it was appropriate when addressing circadian rhythms to not just speak of light but also the lack of light. The reflective, meditative spaces in the dorms are used mostly in the evenings when there is no sunlight, however they are also used at dawn and dusk. For the purposes of the rendering, I focused on portraying the space at night when eyes are closed and light and color are not present. This allowed me to also address the feel of the space. This space thus becomes about the perceptual and auditory and not just about seeing.

With a similar concept that I used in the classrooms, the walls of the dorms only rise 6ft above the floor leaving a 2ft space between the top of the walls and the ceiling, thus allowing for a night breeze flowing constantly throughout the space. For dawn and dusk, the louvers facing east and west in between the walls and the roof shade from the direct penetration of light. In plan, the dorms are arranged into 4 pods. The boys rooms, oriented toward a central hallway monitored by a dorm mother, and the girls pod, being the same. The central pod houses the dorm mothers and the restrooms, and the fourth section located to the north of the site, houses the older students, and the dorm mother monitoring them. Figure 34 below shows the rendering of the space while Figure 35 on the following page gives the quantitative information for it.

Figure 34
Sleep Haven: Qualitative

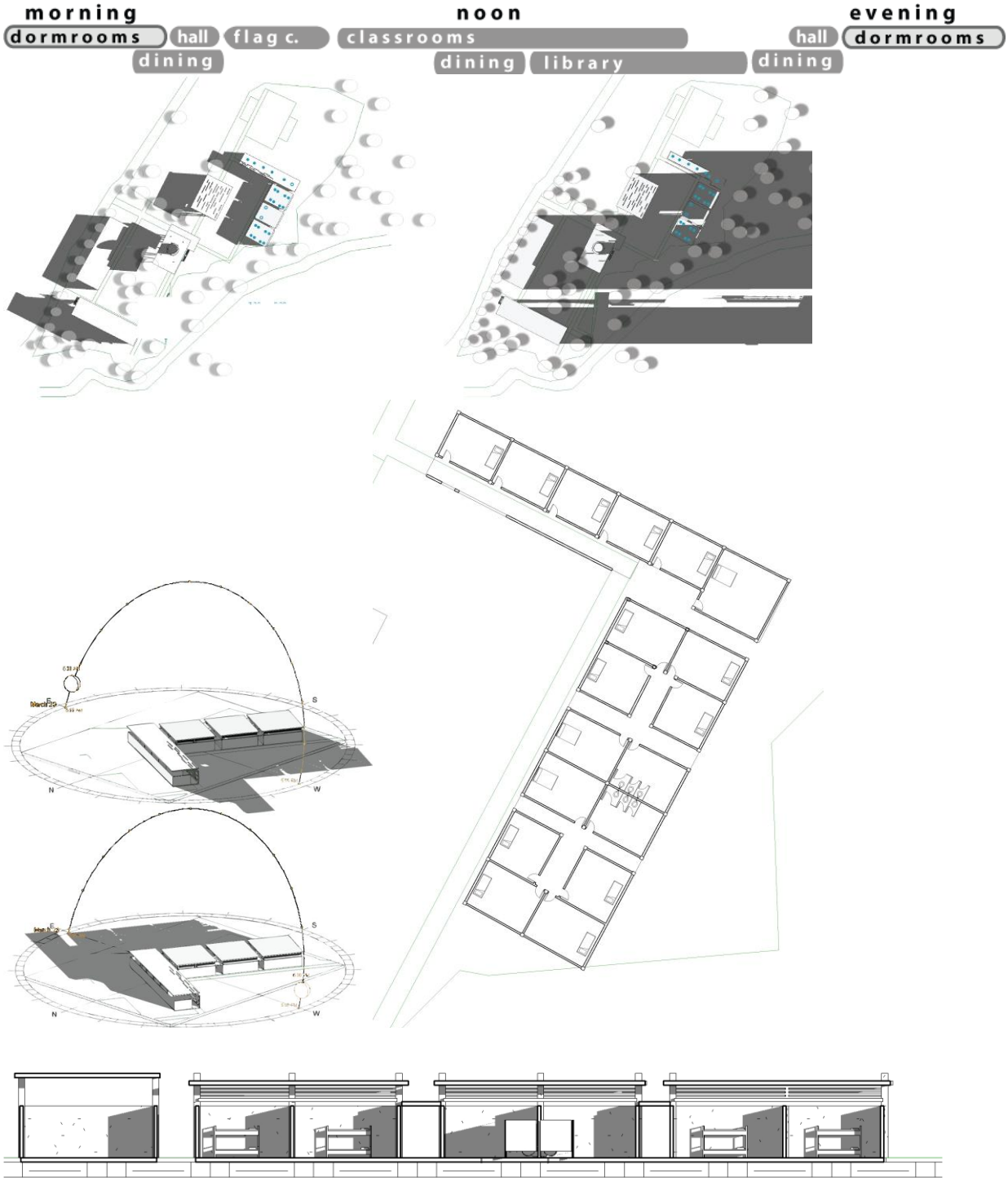

Figure 35
Sleep Haven: Quantitative

CONCLUSION AND OUTCOME

Upon completion of my research, I have come to the conclusion that a holistic approach to design is crucial in achieving a better understanding of the issue and responding to it accurately. By addressing the phenomenological side of design, I was able to fully comprehend the essence of the experience in addition to responding to its quantitative needs. Through approaching each of the spaces I focused on from both, the quantitative and the qualitative side, informed me that either one is incomplete on its own in the understanding of the way light behaves in and interacts with space. By researching the rhythmic patterns of light, its angles and shapes, its temperatures and colors, I was able to get an understanding for the way it interacts with people and their daily rhythms, their functional needs for a space, and the necessary physical treatment of space to facilitate the desired effect for each space.

As an outcome to the study, I have learned that even though the intent for the project began as an attempt to maintain a close physical relationship between man and light, in places where this relationship is already very strong, the designer must consider alternative methods of maintaining a symbiosis. In the case of Fond des Blancs, Haiti, direct sunlight always came with the price of heat, therefore indirect lighting was almost always the solution. Even though in most cases this allowed for spaces where the person was not in physical contact with nature, the connection was visible through design responsive to the rhythms of light and those of the human schedules and a creation of symbiosis between the two.

In conclusion to my thesis, I hope to have revealed a beneficial use for highlighting the innate relationship between the person and rhythmic light, and to have responded to it through the design of a series of spaces that cater to the goals of the secondary school. The outcomes of the study are to inform the practice of design and architecture that there lies a true benefit in restoring the link between man and nature. This link, being more present in less developed places such as Fond des Blancs, Haiti, should be embraces instead of ignoring or covering up issues with modern technology. By using the findings of my research in a beneficial manner towards the design of an educative space in Fond des Blancs, I believe the resulting work will also be fundamental to designing multicultural spaces for a society across a spectrum of environments and disciplines.

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